

What Is Claimed Is:

1. An alarm transfer method in a wide area Ethernet network which has Ethernet networks each for accommodating client lines from client terminals and a plurality of types of transmission networks for connecting said Ethernet networks to one another, said alarm transfer method used for mutually notifying
5 said client terminals placed in communication that a fault occurs in said wide area Ethernet network, said alarm transfer method comprising the steps of:

dividing an Ethernet frame sent from one of said client terminal every predetermined fixed length to generate a plurality of fixed-length frames;

generating a capsule comprised of each of said fixed-length frames, a
10 type field for notifying a fault occurring on one of said client lines, a forward relay line fault notification field for notifying a fault occurring in said transmission network in a forward direction, and a backward relay line fault notification field for notifying the fault in a backward direction;

multiplexing said generated capsules for each of a plurality of Ethernet
15 paths set between client terminals placed in communication to generate a frame adapted for said transmission network, and transferring said frame to an Ethernet network which accommodates a destination client terminal; and

demultiplexing said respective capsules from the received frame, and
referencing said type field, said forward relay line fault notification field, and
20 said backward relay line fault notification field to recognize the fault occurring on said one client line or the fault occurring in said transmission network for each of said Ethernet paths.

2. The method according to claim 1, further comprising the steps of:

transferring said forward relay line fault notification down to an egress node which is an edge node of an Ethernet network that accommodates the destination client terminal; and

- 5 issuing a backward relay line fault notification corresponding to said forward relay line fault notification from said egress node to an ingress node which is an edge node of an Ethernet network that accommodates a source client terminal.

3. The method according to claim 2, wherein:

said egress node, upon detection of said forward relay line fault notification, sets a client line downstream of a corresponding Ethernet path to link-down when said fault notification is not cleared even after lapse of a
5 predetermined protection time, and

said ingress node, upon detection of said backward relay line fault notification, sets a client line upstream of a corresponding Ethernet path to link-down.

4. A wide area Ethernet network having Ethernet networks each for accommodating client lines from client terminals, and a plurality of types of transmission networks for interconnecting said Ethernet networks, wherein a fault occurring on one of said client line or in said transmission network is
5 mutually notified between said client terminals placed in communication, said wide area Ethernet network comprising:

a multiplexer which functions as an edge node of said Ethernet network, wherein:

said multiplexer, upon receipt of an Ethernet frame sent from one of said

10 client terminals, divides said Ethernet frame every predetermined fixed length to
generate a plurality of fixed-length frames, generates a capsule comprised of
each of said fixed-length frames, a type field for notifying a fault occurring on
one of said client lines, a forward relay line fault notification field for notifying a
15 backward relay line fault notification field for notifying the fault in a backward
direction, multiplexes said generated capsules for each of a plurality of Ethernet
paths set between client terminals placed in communication to generate a
frame adapted for said transmission network, and transfers said frame to an
Ethernet network which accommodates a destination client terminal; and
20 said multiplexer, upon receipt of a frame from said transmission network,
demultiplexes said respective capsules from said frame for each of Ethernet
paths set between client terminals placed in communication, and references
said type field, said forward relay line fault notification field, and said backward
relay line fault notification field to recognize the fault occurring on said one
25 client line or the fault occurring in said transmission network for each of said
Ethernet paths.

5. The wide area Ethernet network according to claim 4, wherein:

said multiplexer issues said forward relay line fault notification to an
egress node which is an edge node of an Ethernet network that accommodates
a destination client terminal when said multiplexer operates as an ingress node
5 which is an edge node of an Ethernet network that accommodates a source
client terminal; and

said multiplexer, upon detection of said forward relay line fault
notification, issues a backward relay line fault notification corresponding to said

forward relay line fault notification toward said ingress node, when said
10 multiplexer operates as said egress node.

6. The wide area Ethernet network according to claim 5, wherein:
said multiplexer, upon detection of said forward relay line fault
notification, forcefully sets a client line downstream of a corresponding Ethernet
path to link-down when said fault notification is not cleared even after lapse of a
5 predetermined protection time when said multiplexer operates as said egress
node, and

said multiplexer, upon detection of said backward relay line fault
notification, immediately sets a client line upstream of a corresponding Ethernet
path forcefully to link-down when said multiplexer operates as said ingress
10 node.

7. A wide area Ethernet network comprising:
an ingress node for dividing a higher-level protocol data sent from each
of a plurality of client terminals every predetermined fixed length to generate a
plurality of fixed-length frames, generating a capsule comprised of each of said
5 fixed-length frames, a CRC field for detecting whether or not the data sent from
said each client terminal is normal, a type field for notifying a fault occurring on
a client line, a forward relay line fault notification field for notifying a fault
occurring in a transmission network in a forward direction, and a backward relay
line fault notification field for notifying said fault in a backward direction,
10 multiplexing said capsules in a predefined order and adding an FCS field for
detecting whether or not data in said capsules is normal to generate a
multiplexed MAC frame, and sending said multiplexed MAC frame; and

an egress node for detecting a defective data reception for each Ethernet path from the result of checking said CRC field added to said fixed-length frame, detecting a relay line fault in the forward direction and in the backward direction for each Ethernet path from information in said type field, said forward relay line fault notification field, and said backward relay line fault notification field, identifying an alarm for a path network layer from said detected defective data reception and said relay line fault information, detecting a defective data reception for each line from the result of checking said FCS field added to said multiplexed MAC frame, and detecting loss of signal and link-down for each line to identify an alarm for a transmission medium network layer.

8. The wide area Ethernet network according to claim 7, further comprising:

a relay node for relaying said multiplexed MAC frame transmitted/received between said ingress node and said egress node by multiplexing frames defined by SONET/SDH into said multiplexed MAC frame or demultiplexing said multiplexed MAC frame into said SONET/SDH defined frames, identifying an alarm on a path-by-path basis from a POH byte defined by said SONET/SDH, and identifying an alarm on a section-by-section basis from an SOH byte defined by said SONET/SDH.

9. The wide area Ethernet network according to claim 7, wherein said multiplexed MAC frame comprises a multiplexed MAC frame header placed at top of said multiplexed capsules, said header including a sequence number, a K1 byte, a K2 byte, and an HEC field.

10. The wide area Ethernet network according to claim 9, wherein:

said ingress node and said egress node are connected through an active line and a spare line, and each generate an SD signal and an SF signal from the results of said defective data reception, said loss-of-signal detection, and
5 said link-down detection detected for each line; and

said ingress node and said egress node each generate a K1 byte and a K2 byte to be transmitted from the K1 byte and K2 byte received thereby and the SD signal and the SF signal for each line, store said transmission-related K1 byte and K2 byte in said multiplexed MAC frame header for transmission,
10 and make a determination for switching a line to which said multiplexed MAC frame is delivered between said active line and said spare line, and switch the line to which said multiplexed MAC frame is delivered from a result of the determination.

11. The wide area Ethernet network according to claim 8, wherein:

said multiplexed MAC frame has a multiplexed MAC frame header placed at top of said multiplexed capsules, said header including a sequence number, a K1 byte, a K2 byte, and an HEC field.

12. The wide area Ethernet network according to claim 11, wherein:

said ingress node and said egress node are connected through an active line and a spare line;

said ingress node and said relay node are connected through an active
5 line and a spare line;

said egress node and said relay node are connected through an active line and a spare line;

each of said ingress node, said egress node, and said relay node generates an SD signal and an SF signal from a result of said defective data reception, said loss of signal, and said link-down detected for each line, and
10 each of said ingress node, said egress node, and said relay node generates a K1 byte and a K2 byte to be transmitted from the K1 byte and K2 byte received thereby and the SD signal and the SF signal for each line, stores said transmission-related K1 byte and K2 byte in said multiplexed MAC frame
15 header for transmission, and makes a determination for switching a line to which said multiplexed MAC frame is delivered between said active route and said spare route, and switches the line to which said multiplexed MAC frame is delivered from a result of the determination.

13. An Ethernet multiplexer for relaying information transmitted/received between Ethernet networks for accommodating client lines from client terminals and a plurality of types of transmission networks for connecting said Ethernet networks to each other, said Ethernet multiplexer
5 serving as an edge node of each of said Ethernet networks, comprising:
a GbE_MAC processing circuit for transmitting and receiving a frame to and from said transmission networks, and for detecting a fault occurring on any of said transmission networks;
a TDM_MUX/DEMUX circuit for time-division-multiplexing or
10 demultiplexing frames transmitted in an upstream direction or in a downstream direction in units of a plurality of Ethernet paths set between client terminals placed in communication;
an FE_MAC processing circuit for detecting transmission/reception of an Ethernet frame to/from one of said client lines, and detecting a fault occurring

15 on said one client line; and

a GBP processing circuit, in response to a received Ethernet frame sent from one of said client terminals, for dividing said Ethernet frame every predetermined length to generate fixed-length frames, generating a capsule including a core block composed of each of said fixed-length frames and a type field added thereto for notifying a fault occurring on said one client line, a forward relay line fault notification field for notifying a fault occurring in said transmission networks in a forward direction, and a backward relay line fault notification field for notifying said fault in a backward direction, said GBP processing circuit, upon detection of a fault occurring on one of said client lines, adding a code indicative of the fault on said one client line to said type field, and overwriting a payload with a predefined idle frame, said GBP processing circuit, upon receipt of a frame from one of said transmission networks, monitors said core block, said forward relay line fault notification field, and said backward relay line fault notification field, respectively, to identify a fault occurring on said one client line or a fault occurring in said transmission networks for each of said Ethernet paths.

14. The Ethernet multiplexer according to claim 13, wherein:

said GBP processing circuit issues said forward relay line fault notification to an egress node which is an edge node of an Ethernet network that accommodates a destination client terminal when said GBP processing circuit operates as an ingress node which is an edge node of an Ethernet network that accommodates a source client terminal; and

said GBP processing circuit, upon detection of said forward relay line fault notification, issues a backward relay line fault notification corresponding to

said forward relay line fault notification toward said ingress node when said
10 GBP processing circuit operates as said egress node.

15. The Ethernet multiplexer according to claim 14, wherein:

said GBP processing circuit, upon detection of said forward relay line
fault notification, forcefully sets a client line downstream of a corresponding
Ethernet path to link-down when said fault notification is not cleared even after
5 lapse of a predetermined protection time when said GBP multiplexer operates
as said egress node, and

said GBP multiplexer, upon detection of said backward relay line fault
notification, immediately sets a client line upstream of a corresponding Ethernet
path forcefully to link-down when said GBP multiplexer operates as said ingress
10 node.

16. An Ethernet multiplexer for relaying a capsule transmitted/received
between Ethernet networks each for accommodating client lines from client
terminals and a transmission network for interconnecting said Ethernet
networks, said capsule including a type field for notifying a fault occurring on
5 one of said client lines, a forward relay line fault notification field for notifying a
fault occurring in said transmission network in a forward direction, and a
backward relay line fault notification field for notifying said fault in a backward
direction, said Ethernet multiplexer comprising:

a terminator circuit for transmitting/receiving frames to/from said
10 transmission network, and detecting a line fault in said transmission network;
a TDM_MUX/DEMUX circuit for time-division-multiplexing or
demultiplexing frames transmitted in an upstream direction or in a downstream

direction in a predefined order in units of a plurality of Ethernet paths which are set between client terminals placed in communication;

- 15 a MAC processing circuit for transmitting/receiving frames to/from said Ethernet networks, and detecting a line fault in said Ethernet networks; and
- GBP relay processing circuit for relaying said capsule for each of said Ethernet paths, and in response to a fault detected by said terminator circuit or said MAC processing circuit, setting a code indicative of the presence of a line
- 20 fault in said forward relay line fault notification field, setting a code indicative of the absence of a line fault in said backward relay line fault notification field, setting a code indicative of no fault on said client lines in said type field, and setting a predefined idle frame in a payload.